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Assessment of Illinois Corn Yields in a Unique Wet and Cool Growing Season

Stanley Changnon
Illinois State Water Survey, Institute of Natural Resource Sustainability
Professor of Geography and Chief Emeritus, University of Illinois
E-mail: schangno@illinois.edu

ABSTRACT

The 2009 growing season in Illinois had exceptionally low temperatures and heavy rainfall, serving as the record wettest and coldest growing season. The weather during the growing season produced exceptionally high corn yields that were well above expectations. Crop experts, farmers, and outputs from crop-weather models failed to detect and predict the magnitude of the 2009 yields. The inability to predict the above average yield in 2009 likely resulted from knowledge that past comparably cold-wet seasons had produced relatively low yields. The different outcome in 2009 reflects on-going improvements in plant genetics making them less sensitive to weather stress, and also on improved farm practices that collectively produced a different yield outcome than those in similar growing seasons 10 to 50 years ago.

INTRODUCTION

Illinois crop yields in 2009 were near record highs and occurred in a year with highly unusual growing season weather. Most months from March through November had above average precipitation and below average temperatures. During the cool and wet growing season, agricultural experts predicted below average crop yields (FarmWeek, June 8a, and August 3b). The wet and cold spring greatly delayed planting of corn, usually detrimental yields. Past research has shown that wet-cold springs acted to decreased yields (Thompson, 1969). The wet and cold fall in 2009 delayed harvesting, a situation also considered detrimental to high corn yields (FarmWeek, September 21c and 28). Persistent wetness in past falls delayed harvesting and reduced yields (Garcia et al., 1990).

Another recent year also had unusual weather conditions and high corn yields in Illinois. In 2004 Illinois had an abnormally large number of sunny days with average temperatures and above normal rainfall and the corn yield was 180 bu/acre (Changnon and Changnon, 2005). One explanation for the unexpected outcome in 2004 was that improved crop genetics had resulted in higher corn yields than in prior years with similar stressful conditions.

The goal of this study of 2009 was to describes why near record corn yields came with weather conditions previously thought to be crop limiting. Assessment was based on comparison of yields in prior years with weather conditions similar to those in 2009.

INVESTIGATION

Examination of the past growing seasons weather conditions, dating back to 1940, revealed very few years with wet and cool conditions during most of the growing season. No past year exactly matched the conditions of 2009. The monthly departures from average for precipitation and for temperatures in 2009 are shown in Table 1. The 2009 growing season had precipitation that was 14.6 inches above average and a temperature that was 1.2 degrees below average, and together these are the greatest seasonal departures on record dating back to 1940.

Table 1. Departures from average of monthly temperatures and precipitation in Illinois for March-November 2009

Month	Precipitation, inches	Temperature, degrees f
March	+1.0	+2.1
April	+2.4	-0.9
May	+1.6	-0.5
June	+1.2	+0.8
July	+1.1	-5.3
August	+1.4	-2.9
September	0.8	-0.4
October	+6.0	-4.8
November	-0.7	+4.2

Examination of past climate data for Illinois for 1941-2009 found that four past years had growing season conditions similar to those in 2009. These years included 1945, 1970, 1974, and 1990. Their monthly values of temperatures and precipitation, expressed as being above average, near average, or below average, are shown in Table 2 along with the values for 2009.

Table 2. Departures from average of monthly precipitation and temperatures in Illinois for 2009 and four similar years (1).

	Mar		Apr		May		June		July		Aug		Sept		Oct		Nov	
Year	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T
1945	A	A	A	B	A	B	A	B	B	B	A	B	A	B	N	B	B	N
1970	B	N	A	B	A	A	A	A	B	B	A	B	A	A	A	B	B	A
1974	A	A	A	A	A	B	A	A	B	A	A	B	B	B	B	B	A	N
1990	A	A	B	B	A	B	A	N	A	B	A	B	B	A	A	B	A	A
2009	A	A	A	B	A	B	A	A	A	B	A	B	B	N	A	B	B	A

(1) P=precipitation, T=temperature, A=above average, B=below average, N=average.

Comparison of the 1945 values (departures from average) with those in 2009 revealed similar precipitation values + or _ 0.5 inch) in 6 months (not July, September, and October) and similar temperatures (+ or - 1.0 degree) in 6 months. Comparison of the 1970 precipitation values with those in 2009 also reveled agreement in six months, and temperature values were alike in 6 months. The 1974 precipitation values matched those in 2009 in 6 months and temperature values also in 6 months. The precipitation values in 1990 matched those in 2009 in 7 months and temperature values agreed in 7 months. Thus, 1990 was slightly more like 2009 than the other three prior.

Figure 1 presents the annual corn yields for 1941 through 2009 in Illinois, and the corn yields expected under average weather conditions appear as a dashed line. Annual values above the average curve represent high yields resulting from highly favorable weather conditions, and values below the curve reflect relatively low yields from unfavorable weather conditions that lowered yields.

The five yield values for 2009 and the four similar seasons were compared with the expected average yield values, and the results are shown in Table 3. This reveals that 2009 had a corn yield (174 bu/acre) that was 5 bushels above that expected with average weather, a significant difference (Fig. 1). However, the yields in the four similar weather seasons were all below average expectations.

Crop yield-weather models developed during the 1950-1990 period (Odell, 1959, Thompson, 1969, Garcia et al., 1990) were used to test the 2009 weather conditions. All models showed a decrease in corn yields such as those shown in Table 3 for 1945, 1970, 1974, and 1990. These modeling results help indicate why agricultural experts were predicting low yields during 2009. The yield differences were all statistically significant.

Furthermore, field experiments with corn in central Illinois conducted during 1988-1994 involved applications of various increases in the natural rainfall by +10, +25, and +40 percent. These tests showed that the increases of 25 and 40 percent in growing season rainfall led to corn yield decreases in naturally wet seasons (Changnon and Hollinger, 2003).

Table 3. Comparison of corn yields obtained in the five wet and cool growing seasons with yields expected under average weather conditions.

Year	Yield, bu/acre	Average weather yield	Difference, average minus actual
1945	46	55	-9
1970	80	96	-16
1974	98	104	-6
1990	127	131	-4
2009	174	169	+5

SUMMARY

The wet and cool weather during 2009 growing season in Illinois produced exceptionally high corn yields that were well above expectations. Crop experts, farmers, and outputs from crop-weather models failed to correctly predict the magnitude of the state's final yield.

The inability to predict the above average yield in 2009 likely resulted from awareness that past similar cold and wet seasons had resulted in relatively low corn yields. The unique 2009 outcome likely reflects on-going changes in plant genetics making them less sensitive to weather stress, and farm practices that collectively produce different outcomes in recent years from those in similar growing seasons 10 to 60 years ago (Changnon and Hollinger, 2003).

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Figure 1. Annual corn yields in Illinois form 1941-2009, and average yields based on average growing season weather conditions.